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PATENT SPECIFICATION

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PROVISIONAL SPECIFICATION.

Improvements in Apparatus used in Air-lift Pumps.

I, ROBERT STIRLING, of The Anchorage, Dormans Park, in the County of Surrey, Engineer, do hereby declare the nature of this invention to be as follows:—

This invention relates to that part of the apparatus used in the air-lift pump known as the foot piece by which the mixture of liquid and compressed air is obtained to start and maintain the discharge of liquid.

The object of the invention is to obtain an intimate mixture of the liquid and the compressed air, and at the same time to utilise to the best advantage the available head of the balancing column of the liquid, and the energy of the flow of the compressed air used to reduce the specific gravity of the discharge column.

In apparatus of the air-lift type, that is to say in apparatus in which the raising of the liquid depends on the aeration of the liquid in the discharge column, it has been proposed to use a restricted inlet or nozzle for the admission of liquid into the discharge pipe, an air inlet above or below the nozzle adapted to impart velocity to the liquid and mingle therewith, and a throat through which the mingled liquid and air must pass on their way to the discharge pipe. It has also been proposed to provide a separate inlet for admission of air to the discharge pipe immediately above the delivery cone through which the mixture of liquid and air enters the discharge pipe.

Apparatus made in accordance with my invention consists of an annular chamber a restricted inlet or nozzle proportioned to admit the desired quantity of liquid, and a prolonged mixing cone with a series of air inlets disposed in its length terminating in a delivery cone, or alternatively one or more mixing cones and a delivery cone, through which the mingled liquid and air must pass on their way to the discharge pipe. I provide air outlets from the annular chamber, to the discharge pipe at the upper end of the delivery cone to facilitate starting, but the air supply to these inlets is not obtained from a separate inlet, but from the same inlet that supplies the chamber containing the cones, so that after starting the air supply automatically ceases to enter above the delivery cone, and enters with the liquid mixing cone or cones, the pressure at these points being less than at the inlets above the delivery cone.

In discharge pipes of large diameter I may use a group of such combination of nozzles and cones as described in preference to a single combination of larger size, so as to obtain a more intimate mixture of the liquid and compressed air.

In air lift apparatus in which the air supply pipe is carried within the discharge pipe the air supply inlet to the combination or group of combinations of nozzle and cones may be eccentrically or centrally disposed.

[*Price* 6*d.*]

Referring to the diagrams filed herewith:—

Fig. 1 is a section showing an arrangement with a combination with air inlets in the mixing cone.

Fig. 2 is a section shewing an arrangement with one or more detached mixing cones.

Fig. 3 is a section shewing an arrangement of air inlet from central air supply pipe when only one combination is used. With more than two combinations the air inlet would be in the centre.

In Fig. 1 the discharge pipe *a* is provided with a liquid inlet nozzle *b* and a tubular mixing cone *c* forming an annular chamber *d* within the discharge pipe *a*. Air is admitted to the chamber *d* by inlet holes *e*. The upper end of the mixing chamber is flared, forming a delivery cone, and is provided with holes *f* which permit air to pass from the annular chamber *d* to the delivery tube *a*. The mixing chamber *c* is provided with holes *g g* through which air passes from the chamber *d* between the nozzle *b* and mixing cone *c*: *h* is a vent.

In use air is admitted to the chamber *d* and passing through the holes *f* aerates the column of liquid standing in the delivery pipe *a* above the chamber *d* causing the liquid to flow upwards. After the upward flow of liquid and air in the discharge pipe has been started, liquid will flow through the nozzle *b* to the mixing chamber *c*. The pressure in the mixing chamber will consequently fall and air will enter the mixing chamber by the holes *g g* and vent *h* causing the liquid to flow steadily up through the discharge pipe.

In the form shewn in Fig. 2 two mixing cones *c* and *c*¹ and two vents *h* and *h*¹ are shewn. In this case holes in the mixing chamber may sometimes be dispensed with.

In the form shewn in Fig. 3 the nozzle *b* and mixing cone are formed in one with a cylindrical casing *j* and air is admitted to the chamber *d* by a pipe *k* passing through the chamber, open at the bottom and provided with holes *m m* within the chamber.

Dated this 30th day of January, 1918.

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COMPLETE SPECIFICATION.

Improvements in Apparatus used in Air-lift Pumps.

I, Robert Stirling, of The Anchorage, Dermans Park, in the County of Surrey, Engineer, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to that part of the apparatus used in the air-lift pump known as the foot piece by which the mixture of liquid and compressed air is obtained to start and maintain the discharge of liquid.

The object of the invention is to obtain an intimate mixture of the liquid and the compressed air, and at the same time to utilise to the best advantage the pressure due to the head of liquid in which the foot piece is submerged and the energy of the flow of the compressed air supplied.

In apparatus of the air-lift type, that is to say in apparatus in which the raising of the liquid depends on the aeration of the liquid in the discharge column, it has been proposed to use a restricted inlet or nozzle for the admission of liquid into the discharge pipe, an air inlet above or below the nozzle adapted

to impart velocity to the liquid and mingle therewith, and a throat through which the mingled liquid and air must pass on their way to the discharge pipe. It has also been proposed to provide a separate inlet for admission of air to the discharge pipe immediately above the delivery cone through which the mixture of liquid and air enters the discharge pipe.

Apparatus made in accordance with my invention consists of a chamber referred to hereafter as the distributing chamber, a restricted inlet or nozzle proportioned to admit the desired quantity of liquid, a prolonged mixing chamber with a series of air inlets disposed in its length terminating in a tapered orifice referred to hereafter as a delivery cone, or alternately one or more mixing chambers referred to hereafter as mixing cones and a delivery cone, through which the mingled liquid and air must pass on their way to the discharge pipe. I may provide air outlets from the distributing chamber, to the discharge pipe at the upper end of the delivery cone to facilitate starting, but the air supply to these inlets is not obtained from a separate inlet, but from the same inlet that supplies the distributing chamber containing the mixing chamber or mixing cones, so that after starting the air supply automatically ceases to enter the discharge pipe at the upper end of the delivery cone, and enters with the liquid the mixing cone or cones, the pressure at these points being less than at the inlets above the delivery cones. The air supply to the distributing chamber is disposed below the level of the holes or outlets from the distributing chamber to the mixing chamber or mixing cones so that the air cannot escape by the upper holes and leave the lower holes submerged.

In discharge pipes of larger diameter I may use a group of such combination of nozzles and cones eccentrically or centrally disposed within the distributing chamber in preference to a single combination of larger size as described so as to divide the flow into several streams and thus obtain a more intimate mixture of the liquid and compressed air.

In air lift apparatus in which the air supply pipe is carried within the discharge pipe the air supply inlet to the combination or group of combinations of nozzle and cones may be eccentrically or centrally disposed.

Referring to the diagram filed with the provisional specification.

Fig. 1 is a section of a foot piece showing air inlets in the mixing chamber.

Fig. 2 is a section of a foot piece showing one or more detached mixing cones.

Fig. 3 is a section of a foot piece showing the air supply pipe disposed within the discharge pipe.

Fig. 4 filed herewith is a similar view to Fig. 3.

In Fig. 1 the discharge pipe *a* is provided with a liquid inlet nozzle *b* and a tubular mixing cone *c* forming a distributing chamber *d* within the discharge pipe *a*. Air is admitted to the chamber *d* by inlet holes *e*. The upper end of the mixing chamber is flared, forming a delivery cone, and is provided with holes *f* which permit air to pass from the distributing chamber *d* to the delivery tube *a* to facilitate starting. The mixing chamber *c* is provided with holes *g g* through which air passes from the distributing chamber *d* into the mixing cone *c*, *h* is a vent by which air also enters the mixing cone. The discharge pipe *a* is adapted to be placed within a pipe not shewn and air supplied to the annular space between the pipes in a well known manner.

In use air is admitted to the distributing chamber *d* and passing through the holes *f* aerates the column of liquid standing in the delivery pipe *a* above the distributing chamber *d* causing the liquid to flow upwards. After the upward flow of liquid and air in the discharge pipe has been started, liquid will flow through the nozzle *b* to the mixing chamber *c*. The pressure in the mixing chamber will consequently fall and air will enter the mixing chamber by the holes *g g* and vent *h* causing the mixture to flow steadily up through the discharge pipe

In the form shewn in Fig. 2 two mixing cones *c* and *c*^{1} and two vents *h* and *h*^{1} are shewn. In this case holes in the mixing chamber may be dispensed with.

More than two mixing cones may be used if desired.

In the form shown in Figs. 3 & 4 the nozzle *b* and mixing cone are formed in one with a cylindrical casing *j* and air is admitted to the distributing chamber *d* by a pipe *k* passing through the chamber, open at the bottom and provided with holes *m m* within the chamber.

These holes are preferably disposed below the level of the vent *h*, as shewn in Fig. 4 so that the air cannot escape by the upper holes and leave the lower holes submerged. More than one combination of nozzle and mixing cone can be used if desired.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. In air lift pumps a foot piece comprising a distributing chamber, a mixing chamber or mixing cones within said chamber, a restricted liquid inlet or nozzle disposed axially of said mixing chamber or mixing cones, means for supplying air to the distributing chamber and thence to the mixing chamber or mixing cones, and a delivery cone through which the mingled liquid and air must pass on their way to the discharge pipe.

2. A foot piece as claimed in Claim 1 characterised in that the air supply pipe disposed within the discharge pipe, passes into the distributing chamber.

3. A foot piece as claimed in Claim 1 and 2 further characterised in that the air inlets from the air supply pipe to the distributing chamber are below the inlets from the distributing chamber to the mixing chamber.

4. A foot piece as claimed in the preceding claims further characterised in that holes are provided in the upper end of the discharge pipe to facilitate starting.

5. A foot piece for an air lift pump constructed arranged and adapted for use substantially as described with reference to the accompanying drawings.

Dated this 23rd day of July, 1918.

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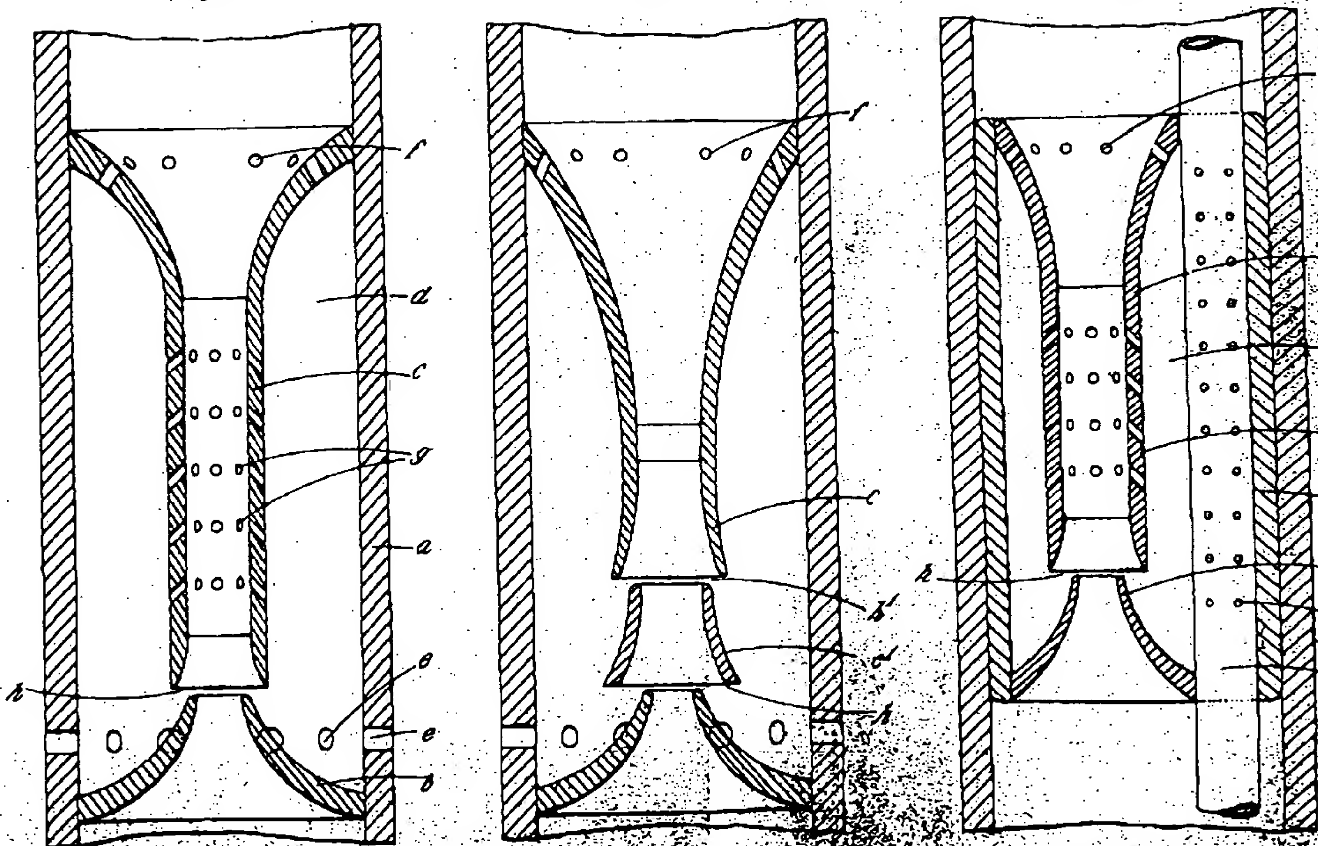
Fig. 1. Fig. 2. Fig. 3.



[This Drawing is a full-size reproduction of the Original.]